

Author's response (Güntzel et al., Preprint egusphere-2025-2515)

Dear Reviewers,
Dear Handling Editor,

We acknowledge all the concerns and helpful comments you made on the previous version of our manuscript and addressed them in the following letter. In the revised version, we made substantial changes to the structure of the results and interpretation sections, as well as the discussion, to streamline the manuscript to address the concern of the disjointed narrative and make the argumentation clearer. We furthermore did some grammar and typo correction, and we also adjusted all the figures (see 'in general' responses RC1 below).

We furthermore want to add that we cite the methodological manuscript "Kattein, L., Höhn, M., Grotheer, H., Gentz, T., Mollenhauer, G.: Introducing a Ramped Pyrolysis/Oxidation-¹⁴C₂-analysis system operated with mobile molecular sieve traps, submitted to *Limnology & Oceanography: Methods*, 2026" in our method section. If needed, we can provide the submitted version of this manuscript.

During our revision, we decided to adjust the DeltaR value for our radiocarbon ages since the DeltaR of 900 in the initially submitted version of the manuscript was outdated (Marine13). We now use the reservoir correction of 1,300 yrs BP (DeltaR 750) following Heaton et al. (2020). A more detailed explanation is found in the responses to RC1 below. We apologize, and we corrected the ages throughout the manuscript. This correction does not change our interpretation.

In the following response letter, we begin by addressing the comments from Reviewer 1, followed by those made by Reviewer 2. The comments are in bold and our answers in italics (blue). Our line references refer to the revised manuscript (non- tracked version).

We uploaded a revised version (non-tracked) and a revised version (tracked) as well as revised supplements to the manuscript.

We once again thank the reviewers for the valuable feedback, which has significantly improved the quality and clarity of our manuscript. We hope that the revisions satisfactorily address all concerns.

Thank you for your time and expertise.
Best wishes,
Janina Güntzel (on behalf of all co-authors)

RC1: 'Comment on egusphere-2025-2515', Sarah Greenwood, 04 Sep 2025

In general:

Language:

There are countless cases of ambiguous use of this, these, it, they, which, and other such pronouns – sentence by sentence needs attention to ensure that the meaning is always clear. There are several cases of poorly chosen or imprecise word choices, which I've tried to highlight in detailed comments below.

We sincerely apologize for the misleading pronouns and hope we have found and clarified all of these pronouns in the manuscript. We made an effort to rephrase misleading paragraphs that were highlighted and corrected some typos.

Structure:

I strongly recommend revising sections 4 & 5 into a combined Results & Interpretations section, in which morphological observations are immediately followed by morphological interpretations, and

then sediment core results are immediately followed by sediment interpretations. The current order, alternating between morphology and cores, produces a very disjointed narrative, and in fact I had to read 4.1 followed by 5.1 in order to follow the evidence and the story, before returning to do the same with the sediments.

We have streamlined the manuscript and improved the coherence of the Abstract, Introduction, and Discussion, with a particular focus on strengthening the connections between the three main themes: grounding line stability, retreat from the Last Glacial Maximum (LGM) to the Holocene, and ocean interactions. These revisions were made to address the previously disjointed narrative.

In addition, we revised the structure of both the Study Area and Discussion sections to improve overall flow. We agree that the manuscript benefits from a closer integration of results and interpretation; accordingly, the Results chapter has been reorganized so that geomorphological results (Section 4.1) are immediately followed by their interpretation (Section 4.2), and sedimentological results (Section 4.3) are directly followed by their interpretation (Section 4.4).

As part of this restructuring, Figure 5 (geomorphology/bedforms) has been moved back to the Results section and renumbered as Figure 3. Tables 2 and 3 have also been repositioned and renumbered accordingly: Table 2 now presents the assignment of depositional environments, and Table 3 summarizes the radiocarbon ages.

Morphology and Sediments:

In part reflecting the structural problems, I found 4.1 difficult to follow. The language is unclear (ambiguous pronouns) and the reader really needs close reference to both Figs 2 & 5 (all panels) in order to follow the geography and the different landform descriptions – Fig 5 should be brought forward in figure sequence. There are references to features previously reported in literature that are missing from the figures, and while most of 4.1 describes landforms in generic morphological terms, there are occasional interpretations of specific glacial landforms given. I suggest if this section is immediately followed by 5.1, both sections of text can be tightened and refined.

Sediment results & facies interpretation: in both of these sections, the descriptions of core stratigraphy are vague and difficult to follow. Phrases such as “towards the top” or “upward” are imprecise. Revise to refer to specific depth intervals, or specific units – all cores presented appear to have 3 units, and referring to these explicitly by number or letter would avoid confusion. Many of the interpretations of sediment units in 5.2 are vague, and don’t draw on specific evidence-closer reference to Table 3 would help here, and/or a more full explanation of reasoning in the text.

The grounding-zone wedges (GZWs) previously identified by Mackintosh et al. (2011) have been labeled as GZW-I and GZW-II to improve clarity in both the text and figures and to facilitate readability. In addition, the core descriptions have been revised and reorganized to enhance clarity and ease of interpretation. We restructured the sediment description and added depth intervals. We also added more references to the table and the figures when talking about certain interpretations. (see answers to the line-by-line comments below, for more details).

Figures:

Fig. 1:

Consider using a more limited colour ramp range, to better bring out differences in water depth on the continental shelf

- Inset – Pacific Ocean label is much smaller than the others

- Caption – refer to the variable first, then colour code, i.e. Polar front (orange), southern ACCF (green) and ACC (white) are indicated in... Define ACCF and ACC. Suggest also “The investigated data” rather than only mentioning cores.

We corrected the size of the label 'Pacific Ocean' and added the label Wild Canyon. We furthermore added the locations of the cores (incl. the legacy cores used in the discussion) as colored stars to the map. We adjusted the depth scale for a better representation of the troughs on the continental shelf. We added the definition of ACCF and ACC to the Figure description.

Fig.2: We adjusted the depth scale for a better representation of the troughs on the continental shelf and added depth labels to the isobars. We labelled the GZWs identified in Mackintosh et al.) and added the RAISED 20ka presumed LGM limit of the grounded ice.

Fig.3 (previously Fig. 5):

The grey hillshaded (? – _or are they slope visualisations?) multibeam images are too pale or bright to see anything. Apparent GZWs (labelled) are completely invisible, scours and gullies in (c) are indistinguishable from each other, and scours in (a) are invisible. I suggest using a conventional hillshade with illumination from either NW or NE, depending on the orientation of relevant landforms, and make sure the greyscale ramp is extensive enough to clearly see landform morphology.

- Identify and label GZWs that you refer to in the text, whether your own interpretation or those that have been previously identified.

- Consider a less diffuse background bathymetry colour ramp – _it is also not bright or varied enough to be meaningful, we can't see any bathymetric variation in it. There should also be a colour ramp legend for the background.

- Is the placement of core sites in (c) correct? Or the colour ramp? The subbottom profile Y-Y'_ _places core sites in topographic lows, but on the map view at least 46_1 looks to be on a topographic high.

We increased the resolution (25 x 25 m) of the hillshaded bathymetry and added some mapping and labels for the MSGs (blue dotted lines) and the GZW-I (panel c) to improve visibility. We addressed the questions regarding the resolution and the visibility of the GZWs in the associated comments below. We removed the background map because it is not needed.

Fig. 4 and Fig. 5 (previously Fig. 3 & 4):

Consider swapping 39-1 and 45-1 around within Fig 3, so core 45-1 is on the left. It is introduced first in the text, so we expect to consult the left side of the diagram first.

- Increase in the contrast in all CT/x-ray images?

- Suggest colouring the axis values according to the variable presented, e.g. MS values in red, as well as the MS label. This reinforces which lines relate to which axes, and you could then delete the dotted line legends under shear strength and C-N (which took me a while to recognise for what they are).

- Comment in the Methods why different cores appear to have different resolution data, in both the sampled variables and the MSCL logged variables. E.g. 45-1 seems to have lower resolution results than 39-1.

We adjusted the brightness of the CT-Scans and added the corrected 14C ages. We also added a close-up view for the diatom-rich laminations in Fig. 5. We deleted the dotted line from the axes. The original X-ray scans (and core photos) are also archived on the PANGAEA database. The sampling resolution is the same as in every other core (every 10cm in core 39, and has been only varied in all cores guided by lithological or structural changes (which sometimes required closer sampling). The MSCL log was already measured onboard RV Polarstern (every cm). We added a description to the method section.

Fig.6:

This figure ought to be more tightly integrated with the Discussion, including all the processes, environments and features labelled. What is the significance of katabatic winds? What is the significance of polynya formation? The sea ice zones labelled look more like iceberg zones in your sketches.

We added some further labels and changed the appearance of the sea ice zone. We refer now to the different panels of Figure 6 in the discussion.

Line by line:

15: that all modern observations are “of limited value” is a bit harsh! Reframe this.

We apologize and agree that it sounded a bit harsher than it was meant to be. We rephrased it in line 16 and 17.

47: ambiguous pronoun – what does “they” refer to? (However, they concluded)

We apologize for all the ambiguous pronouns and did our best to clarify.

51: ambiguous pronoun – what does “it” refer to? (From here, it)

(I note these two as examples of ambiguous pronouns. They occur throughout the manuscript and the authors should carefully check sentence by sentence.)

It refers to the CDW mentioned in the sentence before. We re-structured the paragraph line 51-56.

52: define CDW

Done. Line 41.

59-64: these sentences are muddled and contain repetitive phrases

We rephrased the paragraph. Line 57-64.

66-69: repeats previous sentences

We rephrased the paragraph. Line 57-64

70-1: revise to end with a more concrete statement – shut-off does mean absent or different.

Done. Line 63-64.

73: “cross-cutting” implies two features are superimposed but with different orientations, i.e. one cuts across another. Troughs are not typically cross-cutting. “cross-shelf troughs” would be a better way to phrase what I think you mean.

Thank you, we corrected the term. Line 67.

77-8: missing/incorrect word – prominent what? The main rock types, or lithologies? (And perhaps you mean predominant?) Sentence should end “formed ~3100-2800 Ma ago”.

We deleted this part from the Study area to streamline the text and because we reconsidered and it is not relevant for our results.

79: since you refer to both continental shelves and ice shelves, clarify which you mean: “The continental shelf area is bounded by”

We corrected this. Line 66-82. We clarified in the entire paragraph, if we speak about the continental shelf.

89-90: ambiguous “which”. Suggest break into two sentences, with the second: “These GZWs, which are at equal water depths in both troughs, are thought to mark the most recent expansion of the ice sheet onto the continental shelf.” Suggest also “limits” or “limits of expansion” instead of “most recent expansion”.

We fully agree and corrected this. Line 82-85.

92-6: this paragraph doesn't follow from the previous – it would benefit from an opening sentence that lets us know the relevance. Locations of the Cape Darnley polynya and Wild Canyon ought to be shown on a figure. Who has “newly described” CDBW? Provide a reference or otherwise clarify or delete. Also clarify “grounded iceberg tongue” – an ice tongue is usually considered an elongate ice shelf, i.e. floating, so what do you mean by iceberg tongue? The text doesn't explain the formation of CDBW – are we to assume it's equivalent to ISW? Or DSW? I suggest reducing the acronyms and names for each state, and focus on describing the process.

We added Wild Canyon to Figure 1, Cape Darley is already labelled in Figure 1 and we describe the location of the polynya more detailed in the text now. Line 72-77. We agree that it was confusing and clarified where the information comes from and why it is relevant. Line 74;76. Yes, CDBW is equivalent to DSW. We clarified this now. We used the term 'grounded iceberg tongue' from Oshima et al. 2013, but to keep it simple, we deleted this term. Line 72-77.

105: this section launches into data collection specifics without any introduction. What is PS128? It would be helpful for part of lines 125-6 to be moved here (did you originally have the sediment coring section first, or even didn't originally include any geophysical data in the manuscript?).

We moved the description of the expedition and included a data introduction, clarifying which data are legacy data and which data are from PS128. Line 94-104. We clarified what we did on the cruise PS128. Line 109-120.

106-8: awkward wording, and it's not clear what your set up choices were – are the opening angle settings yours? Suggested edits: “The frequency of the MBES system... and transducers are arranged in a Mills cross...” (?). “In water depths <2000m, the opening angle was set to 70°, while in greater depths the angle was reduced to 50° either side of nadir.

We agree that this paragraph was not clear enough and we rephrased it, clarifying the expedition settings. Line 114-120.

109-110: “Afterward, the data” – which data – new and legacy data were processed together? 50m x 50m seems rather coarse resolution for modern multibeam systems in these water depths – did you try gridding at higher resolution? Or was data too noisy or sparse for that?

We clarified the description of the multibeam data and added a data description at the beginning of the chapter (see previous comments). We also gridded the data to a 25 x 25 m resolution and added these grids to the manuscript. Gridding them to a higher resolution did not change the perception of the submarine bedforms because most features were on larger scales, and the GZWs are too small (~6 m height) to see them even on 25 x 25 m grids. For our interpretation, we identified the GZW on the subbottom profiles (see Figure 3).

111: Redundant wording. Suggest “Sub-bottom profiles were acquired with a Teledyne...”

Thank you, we rephrased.

112-123: the rest of this paragraph is muddled, and should be revised to clarify settings that contribute to penetration, vertical resolution, lateral resolution, and footprint.

We agree and apologize for the confusing paragraph. We rephrased and deleted for clarity. Line 114-120.

130: Results refer to CT-scans (images in Figs 3 & 4?) – include these in the Methods

We apologize for forgetting to mention the CT in the methods. We included this in the methods. Line 122-124.

134-165: These methods need a clearer narrative – it is unclear what samples have been taken, from where, how, for what purpose. In this section, first describe the sampling scheme and purpose, before describing how samples were then handled. E.g. line 134 – which samples? Line 141 – what spatula samples? Are these the same as the ones just described, or a new set? Was datable material (line 145) picked from samples – which samples (in relation to those you've just been describing)? Does microfossil extraction (line 162) also relate to picks for dating – mention this first.

We apologize for the confusing description and have rephrased the entire paragraph. We hope that now the working procedure can be followed more easily. Line 122-136.

136: how were inorganic carbon + carbonates removed?; line 138 – clarify bulk sediment organic C.

With 20% HCL. Line 129. The sentence with the bulk sediment does not describe the organic C measurement. It is for the C:N ratio. Here, we used the ground and freeze-dried bulk sample for the Vario Cube analyzer and it is total carbon content, not only organic C. We rephrased the paragraph. Line 122-136.

152: Edit to something like - The maximum reliable age limit... was estimated to be, or determined to be... A limit of 42 radiocarbon ka is something that arises from the method, not a parameter or setting you arbitrarily decide on?

The limit of ~42 ka comes from the MICADAS system. This is the value of the blank age for combusted samples, which lies between ~39-47 ka BP depending on the combustion method (gas, graphite..) Mollenhauer et al., <https://doi.org/10.1016/j.nimb.2021.03.016>, 2021.

164: revise “carefully considering” – having considered, what deltaR values did you use?

*We had to change our DeltaR to our previous answer from the response Letter: We calibrated the radiocarbon samples with the software Calib 8.2 (Stuiver and Reimers, 1993). We decided on reservoir correction of 1300 ± 100 yrs BP from Berkman and Forman 1994, GRL for our glacial samples (DeltaR 900) to ensure comparability to other sediment records from the Antarctic Shelf (e.g., Ingolfsson et al. (1998), Anderson et al. (2002), Hillenbrand et al. 2010). We also considered Heaton et al. 2023 approach for modern deltaR for samples younger than 11.5 cal. ka BP and adjusted glacial deltaR for glacial samples >11,5 cal. ka BP). The DeltaR of 900 was outdated (Marine13) and we recalculated the ages now with the correct Delta R of 750 (750=1,300-550) from Marine20. **This re-calculation does not change our interpretation, and we corrected the values throughout the manuscript.** We added information on the used reservoir correction in lines 152-158.*

168-70: inner, mid and outer are geographic descriptors – they don’t need referencing to other studies, or to particular landform assemblages. If you find that the landform assemblages that occur in different zones match the distribution of landforms observed elsewhere, then state this as a result.

We deleted this sentence.

170: why start on the mid-shelf, not inner (or outer)? Consider the order of presentation, and try to be systematic.

We started at the mid-shelf because we do not have sediment cores from the inner shelf, so we only analysed mid and outer shelf bedforms.

171: “subparallel features” and “wedge-like structures” should be followed by semi-colons, and/or the 3 separate groups of features should be numbered, otherwise the list of terms that are supposed to represent 3 groups is confusing.

We agree and added numbers. Line 164-165.

181: delete “Based on this morphology” – the internal composition is its own result, not based on shape.

Done.

179-189: clarify what direction the “length” of a wedge means – in the along-flow direction, i.e. cross-wedge direction?

We added the term along-flow, because we measured the length in paleo ice flow direction. Line 178.

206: refer to Fig 2, not Fig 1

We rephrased the chapter.

209: “shelf break of Nielsen Basin”

We added this in Line 233.

213: “in front of” -> seaward ?

Yes, it means seaward; we adjusted this to seaward. Line 234.

219 + 223: does “poorly rounded” mean angular, and “poor angularity” mean rounded? If so, say so more simply!

We rephrased the chapter to improve clarity. Lines 230-274.

219: ambiguous reference to “previous cores” -> Unlike the lowermost unit from the other outer shelf cores, it has...

We rephrased the entire chapter and added sub-headers 4.3.1 and 4.3.2 to separate the description of the outer shelf cores and the mid-shelf cores. Lines 230-274.

222 onward: “some layers”, “distinct sequences” – it is not clear where in the stratigraphy these layers are found. In the mid-core? At the core top? Where are the fining upwards and coarsening upwards trends, in the stratigraphy? The sentences in lines 227-231 ought to be incorporated into the previous paragraph with a more clear, explicit description of core stratigraphy. Refer to depth intervals, if that helps.

We agree that the description was not clear enough and a bit muddled. We rephrased the entire chapter and added depth intervals. We hope it makes it easier to follow now.

236: “boundary” and “mid-shelf cores” are confusing here – I think you mean an up-core boundary, rather than referring to spatial core site boundaries? Instead: “Above the diamicton unit, the shear strength drops.” ?

We agree that it is confusing and rephrased. Line 259-274.

256: why are 14C ages plotted on the figures, and not calibrated ages?

It was just a personal decision, because we thought it was nice to have the uncalibrated ages in the figures with the error. But we agree that it is more consistent to have the calibrated ages in the figures, because the uncalibrated ages are already indicated in Table 2.

Here, or in the Methods earlier, you should also mention that other published ages are re-calibrated and included in your study. The core sites for these published ages should also be plotted on at least one of your figures. The caption for Table 2 is confusing – you refer to Heaton et al. 2024 for two other cores, yet in the table itself you list Leventer et al. 2006 for these cores, and you add another core/reference from Borchers et al. 2016. Please explain clearly what you’ve included, from where, and whose re-calibration you use.

We added the legacy cores in the method section (Line 156-157) and marked their location in Figure 1. We clarified in Table 3 how we calibrated the ages.

265-275: this paragraph has limited referencing to substrate (or other) controls on ice streaming and lineation morphology. Consider also Livingstone et al 2016 (J. Glac.), Jamieson et al 2016 (J. Glac.), Halberstadt et al. 2016 (Cryosphere), Ó Cofaigh et al. 2007 (JGR), Greenwood et al 2021 (Sci Adv)

We agree that the references got a bit limited because the sentences got moved around a bit during the writing process. We apologize for not checking again. We checked your provided references and included them in the paragraph, including some other relevant references. Lines 196- 220. Thank you.

266: inappropriate reference – King et al. 2009 was a sub-ice sheet study (imaging the active bed), not a continental shelf study of relict landforms.

We removed it and replaced it by e.g., Klages et al., 2014, 2015; Livingstone et al., 2016a; Halberstadt et al., 2016. Line 196-197.

273: relate landform types to your subbottom profiler data? Roches moutonnées and whalebacks are bedrock landforms...

We apologize that the sentence was misleading. We identified the drumlinoid features from the bathymetry data, not the subbottom profile data.

280: see also Simkins et al 2018 (Cryosphere)

Thank you for providing this reference. We checked it and included it in the paragraph. Line 213.

286-8: I don't follow these two sentences. Which previously described GZW, and what interpretation do you make about shelf transitions or cavities that relate to multi-directional iceberg scouring?

Here, we were talking about the (now labelled GZW-II) in Nielsen Basin outer Shelf. We rephrased the sentence. We replaced this interpretation with a more tentative, general interpretation of scours. Line 218-219.

293: what differences in substrate? Please be specific in your interpretations.

We rephrased and specified. Line 198-200.

296-7: GZW superimposition on MSGLS has not been presented in the results section or figure – this seems important and you return to it in the Discussion, so please address specifically.

We added a mapping of the MSGLS in Fig.3, Panel c and described it in Line 218-220.

320 + 335: “towards the top” seems inappropriate in both cases – these units are lower-mid-core

322: what tells you sub-ice shelf, and not due to freely moving icebergs?

We apologize for the misunderstanding. Here, we mean the transitional facies in the middle of the core and meant with “towards the top” that it is above the basal unit but is not the surface unit. We rephrased the entire chapter (see 4.3)

324: what proxy signatures do you find that are indicative of ice shelf break-up and turbation of sediments?

We interpreted this from core PS128_44-1 (Supplement Figure S1). The proxies indicate a turbation of the sediments, e.g. with a diamicton as surface unit (14C ages of ~14 ka BP). We also recognized heavy scouring in the subbottom profiles for core PS128_44-1; this is why we took the 14C ages out of our interpretation. We can not really say if its sub-ice shelf, so we generalized the facies as ‘transitional’ (Line 303-304).

327: meltwater plumes should also leave a distinct sedimentological/physical record, e.g. well-sorted silt fraction, rounding, lamination. E.g. Witus et al 2014 (QSR), Lepp et al 2023 (Cryosphere). What evidence of these do you find, in addition to particular microfossils? The microfossil reasoning should also be more specific – are there particular species that favour fresh or nutrient-rich waters?

*The layers (lamination) we refer to have already been identified by Leventer et al. 2006, Sedwick et al., 2001 and Alley et al. 2018 and are annual iron-rich laminae with phytoplankton species *Corethron* spp. and *Chaetoceros* spp.*

*We likewise identified *Corethron* spp. and *Chaetoceros* spp. resting spores, which are indicative of meltwater input (Leventer et al. 2006, Alley et al. 2018). The sedimentology of the lamination was mainly mud with fine sand and no clasts. We had a high water content of ~50-70% and a TOC maxima. We added a close-up view of these laminations in Figure 5 and clarified the text in Lines 306-310.*

333: higher variability of what?

We rephrased the paragraph, lines 315-326.

338: why grounding line proximal?

The transitional facies of PS128_39-1 has still high clast content with big dropstones and is in the lower part still characterized as a diamicton. This diamicton indicates supply from subglacial sediments close to the GL. It has lower shear strength and at the upper part of the transitional facies we found calcareous microfossils and some sandy mud to sand stratification with an increase in water content, which indicates the transition from GL proximal to stronger glaciomarine influence. Lines 317-323.

340: advanced GL retreat is ambiguous! -> “suggest that the GL had already retreated towards the inner shelf”

We rephrased, thank you.

349: do the sediments/proxies tell you about GL oscillation? An oscillating GL should have already been clearly argued from the landform and sediment evidence

We apologize for using the wrong term. We did not mean oscillation of the grounding zone, which we can see from bedforms, e.g., recessional moraines. We meant a varying subglacial sediment supply from the GL during the retreat. The core location PS128_39-1 is situated in a depression in front of a sill. We concluded that the GL-proximal facies was deposited while the ice sheet was pinned at the sill during retreat, supplying subglacial sediments to the core location. We found coarse but not consolidated material in this facies. We took the term 'oscillating' out. Lines 394-397.

350-5: these arguments are unclear

We apologize that this paragraph was muddled and we rephrased.

361: only a few studies of Mac. Roberson land? Otherwise, this statement is incorrect!

We apologize for the misunderstanding. We meant along the East Antarctic margin compared to the West Antarctic margin. We rephrased. We rephrased this part of the discussion. Lines 354-360.

363: "varves" is widely used in the context of annual laminations -> replace with "layers" or "laminations"

Replaced it with laminations. Line 359.

368-9: delete "a minimum", delete "further"

Deleted 'further' but we need 'minimum' because 12.5 ka is the minimum retreat age from a range

370: if the outer shelf GZW was vacated at 12.5, that doesn't mean that it couldn't have formed during the LGM – just that the limit was stable for a long time. What is the argument for GZW formation at, or "during" the period around 12.5? Are you referring to a single outer GZW or a sequence of GZWs?

We apologize that our description was misleading. We did not imply that the GZW formed around 12.5, the GL was gone around 12,5. We assume it did not form during LGM because we found MSGSLs beneath wedge (grounded fast streaming ice and ice was grounded at the continental shelf break during LGM, the small size of GZW indicates a short stillstand period (~ 6m high, ~1km long)

383: what is the evidence for GL retreat accelerating? Why should that be due to CDW? And what does freshwater have to do with enhanced CDW?

We added that we infer the GL acceleration from the retrograde topography and the short timing between the GL retreat (12.5 ka BP to 11.0 ka BP) from outer shelf core PS128_45-1 and mid shelf core PS128_39-1. Lines 372-379.

The intrusion of relatively warmer CDW causes melting at the ice shelf base and therefore can accelerate retreat at the GL. Freshwater input e.g, DSW can protect the ice shelf base from the CDW and therefore influences stratification in the ice shelf cavity and retreat behaviour.

389: I think the previous AIO ages need drawing into the narrative better, e.g. Previously only bulk/AIO dates were available, and carbonate is a big improvement on those for ... reasons. Published AIO ages from Leventer indicate...

We rephrased the paragraph to make it clearer. Lines 384-403

393-5: you contradict yourself here in a confusing passage: RPO ages help better constrain... reworking complicates efforts to constrain... Does the bioturbation sentence link to the RPO ages sentences? Make these elements of the narrative clearer.

We rephrased the paragraph to make it clearer. Lines 384-403

401: awkward wording -> "for the mid-shelf of Burton Basin, east of Nielsen Basin". You could also note that "These ages are almost identical to ours, and this strengthens..."

Thank you. We changed the wording.

414: spell out ACR, MWP1a, MWP1b. And discuss these forcing mechanisms clearly. How would each drive retreat? Do you conclude that the ACR or MWP1b was important, and why?

You consider the ACR important enough to mention in the abstract, but don't discuss it here beyond the first sentence.

We tried to connect the narrative better and explain the processes and how they are connected. Lines 420-445.

421 onward: you mention various retreat timings from around Antarctica, but these come a little out of the blue – we are expecting discussion of East Antarctic timings, then suddenly and without signalling, we're on the Antarctic Peninsula. Try to build this story more clearly, and then the argument that these different timings might be something to do with the accessibility or intensity of CDW water. CDW as a theme also appears in this paragraph very suddenly. Introduce us to why it's relevant, and then present the evidence and arguments for how it might vary.

We rephrased.

440: this key point about AABW – included in the sub-header – comes without clear connection to the previous discussion.

We rephrased. Lines 440-445.

450-1: and Iceberg Alley? Your Conclusions opening statement should reflect your whole study.

Thank you for noticing. We corrected this.

456-7: how does an age that contradicts LGM formation of an outermost shelf GZW also support grounded ice at the shelf break? Do you mean that the GZW is actually a bit retracted from the shelf break, and that ice sat beyond the GZW at maximum? That hasn't been clear from the earlier presentation.

We apologize for the misunderstanding. The initial retreat age of 12.7 ka BP is from core PS128_45-1 on the outer Shelf. This is not retrieved from a GZW. GZW-II lies a bit more landward from core PS128_45-1, close to PS128_44-1 ca. 10 km. We therefore concluded that if we had grounded ice until 12.5 in front of the GZW-II, GZW-II likely formed after 12.7 and is not LGM age because it was situated beneath the grounded ice. We inferred a similar formation age of GZW-I to GZW-II because of the similarity in bedforms and topography of the troughs. "Do you mean that the GZW is actually a bit retracted from the shelf break, and that ice sat beyond the GZW at maximum?" → so yes, that is what we tried to tell. We tried to clarify this by also labelling the GZWs with GZW-I and GZW-II.

Suggest also mention your radiocarbon timings in the Conclusions?

Thanks, we added our initial retreat age to the conclusion.

460-2: I would delete these last sentences – they repeat the end of your Discussion, and are a weak way to end the paper:

Thank you for this remark. We agree and deleted these sentences.

RC2: 'Comment on egusphere-2025-2515', Ola Fredin, 02 Feb 2026

Specific comments:

Chronology and Interpretation of AIO

The core of the paper's argument rests on the shift from older Acid Insoluble Organic (AIO) chronologies (~14 cal. ka BP) to the new foraminiferal-based radiocarbon ages (~12.5 cal. ka BP). The authors justify this by citing potential contamination in AIO dates. I recommend providing a more robust sensitivity analysis or a deeper discussion on why the foraminiferal ages are more representative of the GL retreat rather than a change in environmental conditions. Moreover, the ages derived from sparse specimens in subglacial till (~28.7 to 34.5 cal. ka BP) are interpreted as "maximum glaciation" ages. The authors should clarify the degree to which these specimens might be reworked and how this affects the "prior to ~12.5 ka BP" advance claim.

We added additional explanation in the method section, lines 141-144. We added additional explanation for the AIO and the reworking in lines 387-391. The species used for the maximum glaciation age are not in situ species and they are retrieved from the subglacial till and therefore reworked. The maximum age does not influence the advance claim, because this is a reconstructed minimum age from in situ foraminifera.

Oceanographic Forcing and the "Dense Shelf" Regime

The manuscript attributes the post-LGM retreat of the GL to the intrusion of modified Circumpolar Deep Water (mCDW) onto the shelf. However, the authors also identify this region as a "dense shelf regime" characterized by strong fronts and the Antarctic Slope Current (ASC), which typically act as a dynamical barrier to such intrusions. To my understanding, in current dense shelf regimes, cross-slope water exchange is generally inhibited by the density of the shelf water and the strength of the slope front. For mCDW to reach the GL at ~12.5 cal. ka BP, a breaching mechanism would have been required. I'm not an oceanographer and could be mistaken, but I suggest the authors expand their discussion (Section 6.2) to address which of the following processes likely dominated during the deglacial period:

1. Wind-Driven Shoaling? Did a shift in the westerly wind belt or local katabatic wind stress reduce the ASC barrier, allowing the thermocline to shoal?
2. DSW "Buffer" Weakening? Did an initial freshening of the shelf (perhaps from increased ice-shelf meltwater) reduce the volume of Dense Shelf Water (DSW), thereby weakening the physical buffer that separates the ice front from offshore heat sources?
3. Topographic Steering? Given the complex bathymetry of the Nielsen Basin and Iceberg Alley, did specific sills or troughs provide geostrophic pathways for mCDW to bypass the slope front even under a cold shelf regime?

Explicitly discussing these ocean-ice interactions would strengthen the study's conclusions regarding the "resilience" and subsequent "accelerated retreat" of the East Antarctic Ice Sheet in this sector. The authors are surely aware of the following papers, but I think they might aid in this discussion.

<https://doi.org/10.1029/2021ms002468>

<https://doi.org/10.1175/jpo-d-21-0143.1>

<https://doi.org/10.5194/tc-19-1873-2025>

<https://doi.org/10.1175/jcli-d-15-0808.1>

<https://doi.org/10.1029/2018jc014907>

<https://doi.org/10.1175/jpo-d-12-0205.1>

We agree and expanded the discussion in lines 423-445. We added the following processes (1) southward migration of westerlies and upwelling of CDW. Herefore, we added your suggested reference from Kusahara et al. and another recently published paper from Fripiat et al., 2026 PNAS about deglacial startification in the polar southern ocean.

We also added an explanation for topographic steering, because Iceberg Alley and Nielsen Basin are deeper cross-shelf troughs. Lines 439-441.

GZW Dynamics and Stabilization

The study identifies several small GZWs on the mid-shelf, suggesting episodic retreat and short re-advance/stabilization phases. It would be beneficial to include a brief calculation or discussion on the sediment flux required to build these features within the proposed post-12.5 ka BP timeframe to ensure the geomorphology is physically consistent with the rapid retreat chronology.

We agree, that sediment fluxes and/or calculations would be beneficial for reconstructing these short-term stabilization events. Unfortunately, sediment fluxes from GL are not available for this area of the Antarctic continental shelf. We also did not find enough foraminifera for radiocarbon dating in cores 41-1 and 42-1 to calculate sedimentation rates for the GZWs. In general, it is really difficult to calculate sediment fluxes for paleo ice streams because the supply might change from basin to basin.

We inferred the short-term stabilization events from the small size of the GZWs and the short timing between GL retreat from outer shelf core PS128_45-1 and mid shelf core PS128_39-1

Technical Corrections

Acronym and Nomenclature

- **AABW/CDBW Transition:** On page 3, the authors introduce "CDBW" (Cape Darnley Bottom Water). In the discussion (Section 6.2), they shift to "AABW" (Antarctic Bottom Water). It should be explicitly stated that CDBW is a specific local variety of AABW to prevent confusion for readers unfamiliar with the Cape Darnley polynya.

Done. Line 81-87.

- **CDW vs. mCDW:** It seems to me the authors uses "CDW" and "mCDW" (modified Circumpolar Deep Water) somewhat interchangeably. Given that pureCDW rarely reaches the inner shelf without modification, the authors should standardize this to "mCDW" when discussing shelf-based triggers.

Done.

- **"cal. ka BP" vs "cal. ka before present":** In line 30, page 1, the authors write "12,5 calibrated kiloyears before the present (i.e., 1950 CE, cal. ka BP)". This is redundant.

We removed this.

Potential Typos and Unclear Wording

We apologize for typos and unclear wording and have corrected them.

- **Page 3, Line 77:** "As part of the East Antarctic craton, the prominent found on the Mac. Robertson Land..." . A noun is missing here (likely "prominent lithologies" or "rocks"). *We deleted this sentence.*

- **Page 9, Line 229:** "PS128_46-1 and 47-1 are heavily bioturbated... likewise abundant in calcareous microfossils..." . This sentence is a bit of a dangling descriptor; it would be clearer as: "The upper units of PS128_46-1 and 47-1 are heavily bioturbated..." .

We rephrased the paragraph.

- **Page 11, Table 2:** Some cells in the table appear untidy or have line break issues;

it is hard to figure out some of the individual cells. This should be checked in the final typesetting.

Done

- Page 18, Line 400: "Borchers et al. (2016) propose a similar AIO deglaciation age... for the mid-shelf of the East from Nielsen Basin situated Burton Basin" . This phrasing "East from Nielsen Basin situated" is hard to read. A clearer version could be: "...situated in the Burton Basin, east of

Done and rephrased. Line 384-386